GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: 3/6/81

Project Title: ETSG Modification and Checkout

Project No: A-2880

Project Director: Mr. M. J. Sinclair

Sponsor: U. S. Army Missile Command; Redstone Arsenal, AL 35898

Agreement Period: From 2/17/81 Until 5/16/81(Perf.); 7/16/81 (Rpts.)

Type Agreement: Delivery Order No. 0010 under Contract No. DAAH01-81-D-A003

Amount: $24,110.40

Reports Required: Monthly Technical and Cost and Performance Reports, Final Technical Report

Sponsor Contact Person (s):

Technical Matters

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U. S. Army Missile Command
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Defense Priority Rating: DO-A2 under DMS Reg 1

Assigned to: EML/EOD (~~School~~ Laboratory)

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Other

CA-3 (3/76)

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

# SPONSORED PROJECT TERMINATION

B-4440

Date: 8/19/81

Project Title: ETSG Modification and Checkout

Project No: A-2880

Project Director: Mr. M. J. Sinclair

Sponsor: U. S. Army Missile Command; Redstone Arsenal, AL

Effective Termination Date: 5/16/81

Clearance of Accounting Charges: 7/16/81 (reporting)

Grant/Contract Closeout Actions Remaining:

x Final Invoice ~~and Closing Documents~~

_ Final Fiscal Report

_ Final Report of Inventions

x Govt. Property Inventory & Related Certificate

_ Classified Material Certificate

_ Other _____

Assigned to: EML/EOD (~~School~~/Laboratory)

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Other _____

CA–4 (1/79)

A-2880

# Monthly Letter Report (Technical)

17 March 1981 through 16 April 1981

and

Cost and Performance

17 March 1981 through 31 March 1981

ETSG MODIFICATION AND CHECKOUT
Contract No. DAAH01-81-D-A003
(A-2880)

Prepared for

U.S. Army Missile Command
CDR, USA MICOM
Redstone Arsenal
Huntsville, Alabama 35898

Prepared by

Georgia Institute of Technology
Engineering Experiment Station
Electro-Optics Division
Atlanta, Georgia 30332

April 21, 1981

## SUMMARY OF WORK

All of the ribbon cables suspected of causing noise problems due to distributed capacitance and adjacent conductor crosstalk have been replaced with ribbon cable over ground plane and resistively terminated as required. The cables in question carrying high speed signals are data and address communications between target loader/lookup rams and intensity scaler, and long and short wave target map card cage interconnections. Other cables frequently connected and disconnected have also been replaced.

A design and remanufacture task is presently underway to improve the mechanical integrity of the card frame assemblies. A welded steel box with rigid, full length card guides is being considered as a possible solution. Exact replacement backplanes are ordered to be installed in the card frames. More substantial rack slides are also being incorporated.

All power supplies and card frame back planes have been grounded to a central buss via No. 6 wire for ground loop considerations.

A new version of MDOS FORTRAN has been received and all of the ETSG software has been recomplied and is presently being debugged. Considerable savings in memory is realized with the new computer as well as fixes to old problems.

## PROBLEMS ENCOUNTERED

The reliability of the target CPU halting sequence is still in question though much improved. An approximate non-recoverable error rate of 1 in $10^6$ is now realized and only seems to give trouble when running diagnostics. Some of the TLR memory chip manufacturers who back ordered a sizable quantity of memory IC's have discontinued that particular part and a direct pin replacement is being sought.

Some minor software bugs have surfaced during the excercising of the system, but all were rectified within a day or so.

PLANS FOR NEXT PERIOD

Continuation on the card frames and a second pass of the Direct Cell B interface card is to be implemented. Six targets and two channels should be run with the breadborad within the next week.

Cost Information A-2880

The following charges have been incurred against the contract during the period March 1, 1981 to March 31, 1981.

| | |
|---|---|
| Personal Services (PS) | $10,166.19 |
| Materials and Supplies | 199.38 |
| Travel | 1,077.96 |
| Overhead (@ 73% of PS) | 7,421.32 |
| Retirement (@11.11% of PS) | 1,028.04 |
| TOTAL | $19,892.89 |

The breakdown of personal services is as follows:

| | Dollars | Approximate Man Hours |
|---|---|---|
| Principal Research Engineers | $ 0.00 | 0 |
| Senior Research Engineers | 3,258.14 | 169 |
| Research Engineers | 2,068.66 | 135 |
| Assistant Research Engineers | 3,926.54 | 320 |
| Student Assistants | 26.25 | 5 |
| Technicians, Machinists | 784.00 | 112 |
| Clerical | 102.60 | 16 |
| TOTAL | $10,116.19 | 757 |

The current financial status of the contract is as follows:

| | Budget as Proposed | Expended | Free Balance |
|---|---|---|---|
| Personal Services (PS) | $9,995.12 | $11,382.42 | (1,387.30) |
| Materials and Supplies | 3,000.00 | 199.38 | 2,800.62 |
| Travel | 3,000.00 | 1,077.96 | 1,922.04 |
| Computer | 0.00 | 0.00 | 0.00 |
| Overhead | 7,296.43 | 8,309.17 | (1,012.74) |
| Retirement | 818.85 | 1,163.16 | (344.31) |
| AS PROPOSED | $24,110.40 | $22,132.09 | $1,978.31 |

Based on present partial funding, the funding and equivalent man hours are sufficient to complete the task. Approximately 70% of the proposed task has been completed.

FINAL REPORT
PROJECT NO. A–2880

# ETSG MODIFICATION AND CHECKOUT

By
M. J. Sinclair

Prepared for

U. S. Army Missile Command
System Simulation Directorate
Redstone Arsenal, Alabama 35809

July 1981

**GEORGIA INSTITUTE OF TECHNOLOGY**

**Engineering Experiment Station**
**Atlanta, Georgia 30332**

1981

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| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
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| 4. TITLE *(and Subtitle)*<br>ETSG Modification and Checkout | | 5. TYPE OF REPORT & PERIOD COVERED<br>Final Technical Report<br>6. PERFORMING ORG. REPORT NUMBER |
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| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>Georgia Institute of Technology<br>Engineering Experiment Station<br>Atlanta, Georgia 30332 | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS<br>Delivery Order No. 0010 |
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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Following the design and implementation phase of this program, the ETSG was integrated into the STINGER/POST hybrid in-the-loop simulation at Redstone Arsenal, AL. Various hardware and software testing and verification diagnostics were implemented and a plan for future maintenance and diagnostics was discussed. Six (6) of the twenty (20) targets originally designed into the system were made to work successfully for the initial phase of the hybrid simulation. New printed circuit card cages were manufactured to solve various mechanical and connector problems encountered. New printed circuit revisions to the direct Cell B (OVER)

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# FINAL REPORT

# ETSG MODIFICATION AND CHECKOUT

BY
M. J. Sinclair

Contract Number DAAH01-81-D-A003
Delivery Order Number 0010

Georgia Tech Project Number A-2880

Prepared for

U. S. Army Missile Command
System Simulation Directorate
ATTN: DRDMI-TDF/Technology Laboratory
Redstone Arsenal, Alabama 35898

Prepared by

Georgia Institute of Technology
Engineering Experiment Station
Atlanta, Georgia 30332

July 16, 1981

# FOREWARD

This report was prepared by the Engineering Experiment Station at Georgia Tech under Contract DAAH01-81-D-A003, Delivery Order No. 0010. The work described was performed in the Electro-Optics Division of the Electromagnetics Laboratory under the supervision of G. E. Riley, Program Director. The objectives and results of the work cover the integration and testing phase of the Electronic Target Signal Generator (ETSG) development. The assistance and technical advice of D. Dublin, contract technical monitor at MICOM is gratefully acknowledged. The contributions by Robert Burt and Paul Pritchard of U. A. H., J. T. Randolph, and G. R. Loefer of the Engineering Experiment Station were most helpful during this phase of the program.

# I. INTRODUCTION

The conceptual design, manufacture, integration and test of a flexible, programmable, hybrid computer controlled Electronic Target Signal Generator (ETSG) for electro-optical seeker simulation work at MIRADCOM has been completed. The ETSG generates a simulated signal equivalent to the detector output of a variety of electro-optical seekers such as REDEYE, STINGER, STINGER/POST as well as known or postulated electro-optical threat seekers.

The basic concept for the ETSG is a hybrid general purpose and special purpose computer which can create and control up to 20 sources of specified shape, size, spatial orientation, spatial position, intensity, and intensity gradient. The simulation of a particular target/background/countermeasure scenario can be made by selecting various combinations of sources to represent the various parts of the total target signature. Each source is then controlled independently. Two independent spectral channels are also available which are controlled independently.

An operator's console and display are used to initialize the simulation and display dynamic position of the seeker field-of-view (FOV) and each target/source position relative to the FOV center. The simulation must be initialized for seeker, target, flare and pulse jammer parameters. After initialization the ETSG accepts dynamic target/source parameters from the CDC 6600 via the Direct Cell Interface. These parameters are then mapped onto a memory representing the seeker image plane. This image plane is then convolved with the seeker scan pattern which may be a reticle or scan pattern such as a rosette. For systems other than reticle, scan signals must be supplied to the ETSG via the seeker electronics or other electronic external to the ETSG. Using either prestored reticle patterns or scan signals, the scan in convolved with the seeker image plane. The resulting digital signal is converted to analog signal, ripple filtered and output as the seeker

detector signal. This signal is supplied directly to the seeker electronics where it is used to generate gyro torquing signals and guidance commands for AD-4 analog computer. The AD-4 supplies flight data to the CDC 6600 which has a 6-DOF airframe simulation. New target/source positions relative to an inertia frame of reference are calculated in terms of missile position, target position and gyro gimbal angles. These outputs are supplied to the direct cell for temporary storage. When the ETSG has completed a new data sample, a priority interrupt to the CDC 6600 is generated This allows the 6600 to clear itself for the next calculation. Simultaneous with this interrupt signal, a handshake operation between the ETSG and Direct Cell Interface allows new target data to be transferred to the ETSG.

Future work is expected for integration and testing the other 14 targets as well as the circuitry required to simulate various reticle seekers, specifically that of conical scan.

This contract provided for the modification and checkout of 6 of the 20 sources, both spectral channels and scan circuitry only associated with rosette in the ETSG. The modification phase consisted of a redesign and remanufacture of the four single and two double card cage frames and associated hardware. This effort resulted from consistent mechanical and connector problems with the first version of the card cages that were unable to successfully hold and mate to mother-board connectors the heavy printed cards. The basic ETSG mother-board/card cage was designed around an S100 type assembly which accommodates 8" x 10" cards in a vertical arrangement. The final design of the ETSG after manufacture of the card cages, required circuit cards 14" x 10" and 14" x 22" mounted horizontally which was too much of a strain on the S100 cages. Full length card guides mounted in a welded steel frame with an indentical mother board has been implemented and will be installed and checked out in the ETSG within the next month.

The original design and printed circuit version of the Direct Cell B circuit card required extensive modifications implemented with cut circuit traces and soldered wire on the rear of the card. After the DCB circuit card was checked out and proved to be a successful design, engineering modifications were itemized and sent along with the schematic to a printed circuit mnaufacture. The revision of the DCB interface will be integrated in the ETSG within the month.

Existing ribbon cables carrying high speed data that contributed to the noise problems were replaced with ground plane ribbon cable and resistively terminated. Also, all signal and power ground straps were tied to a common copper buss bar centrally located. This seemed to reduce noise related problems considerably.